

WHAT IS CLAIMED IS:

1. A vibration correcting device comprising:

a lens unit having an optical axis;

a movable member holding the lens unit, which makes said lens unit movable within a plane orthogonal to the optical axis;

a fixed member for limiting the movement of the movable member in the optical axis direction;

at least three balls disposed between the movable member and fixed member, which can roll between the movable member and fixed member and make relative movements of the movable member and fixed member possible;

a vibration detecting unit, which outputs vibration information corresponding to vibration; and

a drive unit for driving the movable member within the optical axis orthogonal plane in accordance with the vibration information from the vibration detecting unit, which includes at least a drive magnet held by the fixed member and a yoke and a coil held by the movable member, or include at least a drive magnet held by the movable member and a yoke and a coil held by the fixed member, wherein

said drive unit presses the movable member toward the fixed member side by means of a magnetic pressing force caused by magnetic attractive action between the drive magnet and yoke.

2. A vibration correcting device according to Claim 1, wherein

at least a projection for causing magnetic attraction action by said drive magnet is provided on the surface of the yoke at the sides opposed to the drive magnet.

3. A vibration correcting device according to Claim 1, wherein

said balls are formed from a material which does not easily cause magnetic action.

4. A vibration correcting device according to Claim 3, wherein

the material which does not easily cause magnetic action is stainless steel.

5. A vibration correcting device according to Claim 1, wherein

the magnetic pressing force caused by magnetic attractive action between the drive magnet and yoke is greater than the weight of the movable member.

6. A vibration correcting device according to Claim 5, wherein

the magnetic pressing force caused by magnetic attractive action between the drive magnet and yoke is 5 times or more the weight of the movable member.

7. A vibration correcting device according to Claim 1, wherein

to the contact surfaces between said balls and movable member and the contact surfaces between the balls and fixed member, lubricating oil is applied which has viscosity at a degree by which the balls are held between the movable member and fixed member without relying on the pressing force caused by magnetic attractive action between the drive magnet and yoke.

8. A vibration correcting device according to Claim 7, wherein

the lubricating oil is grease.

9. A vibration correcting device according to Claim 1, wherein

on the fixed member, containing portions for containing said balls and limiting the movable ranges of the balls are formed.

10. A vibration correcting device according to Claim 9, wherein

each containing portion is shaped into a quadrilateral with four sides for limiting the movable range of the balls, and

the length of one side of the containing portion is longer than the length resulting from summing the diameter of the balls and the maximum movement amount of said balls in response to the movement of the movable member.

11. A vibration correcting device comprising:

a lens unit having an optical axis;

a movable member holding the lens unit, which makes said lens unit movable within a plane orthogonal to the optical axis;

a fixed member for limiting the movement of the movable member in the optical axis direction;

at least three balls disposed between the movable member and fixed member, which can roll between the movable member and fixed member, and make relative movements of the movable member and fixed member possible;

a vibration detecting unit for detecting vibration, which outputs vibration information corresponding to vibration; and

a pitch direction drive unit for driving the movable member in the pitch direction within the optical axis orthogonal plane and a yaw direction drive unit for driving the movable member in the yaw direction within the optical axis orthogonal plane in accordance with the vibration information from the vibration detecting unit, which include drive magnets held by the fixed member and yokes and coils held by the movable member, or include drive magnets held by the movable member and yokes and coils held by the fixed member, wherein

the pitch direction drive unit and yaw direction drive unit press the movable member toward the fixed member side

by means of magnetic pressing forces caused by magnetic attractive action between the drive magnets and yokes.

12. A vibration correcting device comprising:

a lens unit having an optical axis;

a movable member holding the lens unit, which makes said lens unit movable within a plane orthogonal to the optical axis;

a fixed member for limiting the movement of the movable member in the optical axis direction;

at least three balls disposed between the movable member and fixed member, which can roll between the movable member and fixed member, and make relative movements of the movable member and fixed member possible;

a vibration detecting unit for detecting vibration, which outputs vibration information corresponding to vibration; and

a pitch direction drive unit for driving the movable member in the pitch direction within the optical axis orthogonal plane and a yaw direction drive unit for driving the movable member in the yaw direction within the optical axis orthogonal plane in accordance with the vibration information from the vibration detecting unit, which include drive magnets held by the fixed member and yokes and coils held by the movable member, or include drive magnets held by the movable member and yokes and coils held by the fixed

member;

a pitch directional position detecting unit for detecting the moving position of the movable member in the pitch direction and a yaw directional position detecting unit for detecting the moving position of the movable member in the yaw direction, where the pitch detecting directional axis of the pitch directional position detecting unit and the yaw detecting directional axis of the yaw directional position detecting unit are substantially on and along the optical axis of the lens unit when the movable member is at a neutral position in the pitch direction and yaw direction, wherein

the pitch direction drive unit and yaw direction drive unit press the movable member toward the fixed member side by means of magnetic pressing forces caused by magnetic attractive action between the drive magnets and yokes.

13. A vibration correcting device according to Claim 12, wherein

the pitch directional position detecting unit and yaw directional position detecting unit have detecting magnets held by the movable member and magnetic resistance effective elements which are disposed and fixed to said detecting magnets at predetermined intervals and detect changes in magnetic flux density due to movement of said detecting magnets, and magnetic fluxes with respect to the detecting

magnets pass through the yokes of the movable member.

14. A lens device comprising:

a lens unit which is disposed inside the lens device and has an optical axis;

a movable member holding the lens unit, which makes said lens unit movable within a plane orthogonal to the optical axis;

a fixed member for limiting the movement of the movable member in the optical axis direction;

at least three balls disposed between the movable member and fixed member, which can roll between the movable member and fixed member and make relative movements of the movable member and fixed member possible;

a vibration detecting unit for detecting vibration, which outputs vibration information corresponding to vibration; and

a drive unit for driving the movable member within the optical axis orthogonal plane in accordance with the vibration information from the vibration detecting unit, where said drive unit includes at least a drive magnet held by the fixed member and a yoke and a coil held by the movable member, or include at least a drive magnet held by the movable member and a yoke and a coil held by the fixed member, wherein

said drive unit presses the movable member toward the

fixed member side by means of a magnetic pressing force caused by magnetic attractive action between the drive magnet and yoke.

15. A lens device according to Claim 14, wherein

at least a projection for causing magnetic attraction action by said drive magnet is provided on the surface of the yoke at the side opposed to the drive magnet.

16. A lens device according to Claim 14, wherein

said balls are formed from a material which does not easily cause magnetic action.

17. A lens device according to Claim 16, wherein

the material which does not easily cause magnetic action is stainless steel.

18. A lens device according to Claim 14, wherein

the magnetic pressing force caused by magnetic attractive action between the drive magnet and yoke is greater than the weight of the movable member.

19. A lens device according to Claim 18, wherein

the magnetic pressing force caused by magnetic attractive action between the drive magnet and yoke is five times or more the weight of the movable member.

20. A lens device according to Claim 14, wherein

to the contact surfaces between said balls and movable member and the contact surfaces between the balls and fixed member, lubricating oil is applied, which has viscosity at a



degree by which the balls are held between the movable member and fixed member without relying on the pressing force caused by the magnetic attractive action between the drive magnet and yoke.

21. A lens device according to Claim 20, wherein the lubricating oil is grease.

22. A lens device according to Claim 14, wherein

on the fixed member, containing portion for containing said balls and limiting the movable ranges of the balls are formed.

23. A lens device according to Claim 22, wherein

each containing portion is shaped into a quadrilateral with four sides for limiting the movable range of the balls, and

the length of one side of the containing portion is longer than the length resulting from summing the diameter of the balls and the maximum movement amount of said balls in response to the movement of the movable member.

24. A lens device comprising:

a lens unit which is disposed inside the lens device and has an optical axis;

a movable member holding the lens unit, which makes said lens unit movable within a plane orthogonal to the optical axis;

a fixed member for limiting the movement of the movable

member in the optical axis direction;

at least three balls disposed between the movable member and fixed member, which can roll between the movable member and fixed member and makes relative movements of the movable member and fixed member possible;

a vibration detecting unit for detecting vibration, which outputs vibration information corresponding to vibration; and

a pitch direction drive unit for driving the movable member in the pitch direction within the optical axis orthogonal plane and a yaw direction drive unit for driving the movable member in the yaw direction within the optical axis orthogonal plane in accordance with the vibration information from the vibration detecting unit, where said pitch direction drive unit and yaw direction drive unit include drive magnets held by the fixed member and yokes and coils held by the movable member, or include drive magnets held by the movable member and yokes and coils held by the fixed member, wherein

the pitch direction drive unit and yaw direction drive unit press the movable member toward the fixed member side by means of magnetic pressing forces caused by magnetic attractive action between the drive magnets and yokes.

25. A lens device comprising:

a lens unit which is disposed inside the lens device

and has an optical axis;

a movable member holding the lens unit, which makes said lens unit movable within a plane orthogonal to the optical axis;

a fixed member for limiting the movement of the movable member in the optical axis direction;

at least three balls disposed between the movable member and fixed member, which can roll between the movable member and fixed member and makes relative movements of the movable member and fixed member possible;

a vibration detecting unit for detecting vibration, which outputs vibration information corresponding to vibration;

a pitch direction drive unit for driving the movable member in the pitch direction within the optical axis orthogonal plane and a yaw direction drive unit for driving the movable member in the yaw direction within the optical axis orthogonal plane in accordance with the vibration information from the vibration detecting unit, where said pitch direction drive unit and yaw direction drive unit include drive magnets held by the fixed member and yokes and coils held by the movable member, or include drive magnets held by the movable member and yokes and coils held by the fixed member; and

a pitch directional position detecting unit for

detecting the moving position of the movable member in the pitch direction and a yaw directional position detecting unit for detecting the moving position of the movable member in the yaw direction, where the pitch detecting directional axis of the pitch directional position detecting unit and the yaw detecting directional axis of the yaw directional position detecting unit are substantially on and along the optical axis of the lens unit when the movable member is at a neutral position in the pitch direction and yaw direction, wherein

the pitch direction drive unit and yaw direction drive unit press the movable member toward the fixed member side by means of magnetic pressing forces caused by the magnetic attractive action between the drive magnets and yokes.

26. A lens device according to Claim 25, wherein

the pitch directional position detecting unit and yaw directional position detecting unit have detecting magnets held by the movable member and magnetic resistance effective elements which are disposed and fixed to said detecting magnets at predetermined intervals and detect changes in magnetic flux density due to movements of said detecting magnets, and magnetic fluxes with respect to the detecting magnets are caused to pass through the yokes of the movable member.

27. An optical device having an imaging device for imaging

a subject image formed by a lens device, comprising:

a lens unit which is disposed inside the lens device and has an optical axis;

a movable member holding the lens unit, which makes said lens unit movable within a plane orthogonal to the optical axis;

an image pickup device for imaging the subject image formed by said lens device;

a fixed member for limiting the movement of the movable member in the optical axis direction;

at least three balls disposed between the movable member and fixed member, which can roll between the movable member and fixed member and makes relative movements of the movable member and fixed member possible;

a vibration detecting unit for detecting vibration, which outputs vibration information corresponding to vibration; and

a drive unit for driving the movable member within the optical axis orthogonal plane in accordance with the vibration information from the vibration detecting unit, where said drive unit includes at least a drive magnet held by the fixed member and yoke and coil held by the movable member, or includes at least a drive magnet held by the movable member and yoke and coil held by the fixed member, wherein

said drive unit presses the movable member toward the fixed member side by means of a magnetic pressing force caused by the magnetic attractive action between the drive magnet and yoke.

28. An optical device according to Claim 27, wherein

at least a projection for causing magnetic attraction action by said drive magnet is provided on the surface of the yoke at the side opposed to the drive magnet.

29. An optical device according to Claim 27, wherein

said balls are formed from a material which does not easily cause magnetic action.

30. An optical device according to Claim 29, wherein

the material which does not easily cause magnetic action is stainless steel.

31. An optical device according to Claim 27, wherein

the magnetic pressing force caused by magnetic attractive action between the drive magnet and yoke is greater than the weight of the movable member.

32. An optical device according to Claim 31, wherein

the magnetic pressing force caused by magnetic attractive action between the drive magnet and yoke is five times or more the weight of the movable member.

33. An optical device according to Claim 27, wherein

to the contact surfaces between balls and movable member and the contact surfaces between said balls and fixed

member, lubricating oil is applied, which has viscosity at a degree by which the balls are held between the movable member and fixed member without relying on the pressing force caused by the magnetic attractive action between the drive magnet and yoke.

34. An optical device according to Claim 33, wherein the lubricating oil is grease.

35. An optical device according to Claim 27, wherein on the fixed member, containing portions for containing said balls and limiting the movable ranges of the balls are formed at the fixed member.

36. An optical device according to Claim 35, wherein each containing portion is shaped into a quadrilateral with four sides for limiting the movable range of the balls, and the length of one side of the containing portion is longer than the length obtained by summing the diameter of the balls and the maximum movement amount of said balls in accordance with the movement of the movable member.

37. An optical device with an imaging device for imaging the subject image formed by a lens device, comprising:

a lens unit which is disposed inside the lens device and has an optical axis;

a movable member holding the lens unit, which makes said lens unit movable within a plane orthogonal to the optical axis;

an image pickup device for imaging the subject image formed by said lens device;

a fixed member for limiting the movement of the movable member in the optical axis direction;

at least three balls disposed between the movable member and fixed member, which can roll between the movable member and fixed member and make relative movements of the movable member and fixed member possible;

a vibration detecting unit for detecting vibration, which outputs vibration information corresponding to vibration; and

a pitch direction drive unit for driving the movable member in the pitch direction within the optical axis orthogonal plane and a yaw direction drive unit for driving the movable member in the yaw direction within the optical axis orthogonal plane in accordance with the vibration information from the vibration detecting unit, where said pitch direction drive unit and yaw direction drive unit include drive magnets held by the fixed member and yokes and coils held by the movable member, or include drive magnets held by the movable member and yokes and coils held by the fixed member, wherein

the pitch direction drive unit and yaw direction drive unit press the movable member toward the fixed member side by means of magnetic pressing forces caused by magnetic



attractive action between the drive magnets and yokes.

38. An optical device with an imaging device for imaging a subject image formed by a lens device, comprising:

a lens unit which is disposed inside the lens device and has an optical axis;

a movable member holding the lens unit, which makes said lens unit within a plane orthogonal to the optical axis;

an image pickup device for imaging the subject image formed by said lens device;

a fixed member for limiting the movement of the movable member in the optical axis direction;

at least three balls disposed between the movable member and fixed member, which can roll between the movable member and fixed member and make relative movements of the movable member and fixed member possible;

a vibration detecting unit for detecting vibration, which outputs vibration information corresponding to vibration;

a pitch direction drive unit for driving the movable member in the pitch direction within the optical axis orthogonal plane and a yaw direction drive unit for driving the movable member in the yaw direction within the optical axis orthogonal plane in accordance with the vibration information from the vibration detecting unit, where said

pitch direction drive unit and yaw direction drive unit include drive magnets held by the fixed member and yokes and coils held by the movable member, or include drive magnets held by the movable member and yokes and coils held by the fixed member; and

a pitch directional position detecting unit for detecting the moving position of the movable member in the pitch direction and a yaw directional position detecting unit for detecting the moving position of the movable member in the yaw direction, where the pitch detecting directional axis of said pitch directional position detecting unit and the yaw detecting directional axis of said yaw directional position detecting unit are substantially on and along the optical axis of the lens unit when the movable member is at a neutral position in the pitch direction and yaw direction, wherein

the pitch direction drive unit and yaw direction drive unit press the movable member toward the fixed member by means of magnetic pressing forces caused by magnetic attractive action between the drive magnets and yokes.

39. An optical device according to Claim 38, wherein

the pitch directional position detecting unit and yaw directional position detecting unit have detecting magnets held by the movable member and magnetic resistance effective elements which are disposed and fixed to said detecting

magnets at predetermined intervals and detect changes in magnetic flux density due to the movement of said detecting magnets, and magnetic fluxes with respect to said detecting magnets pass through the yokes of the movable member.

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